

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the matter of)	
)	
Establishment of an Interference Temperature)	
Metric to Quantify and Manage Interference)	ET Docket No. 03-237
and to Expand Available Unlicensed)	
Operation in Certain Fixed, Mobile and)	
Satellite Frequency Bands)	

REPLY COMMENTS OF V-COMM, L.L.C.

Sean Haynberg
Director of RF Technologies

David Stern
Vice President

Dominic Villecco
President

V-COMM, L.L.C.
3 Cedar Brook Drive
Cranbury, NJ 08512
(609) 655-1200

May 5, 2004

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V-COMM, L.L.C. (V-COMM)¹ submits these reply comments in response to the Federal Communications Commission’s (FCC or Commission) Notice of Inquiry (NOI) and Notice of Proposed Rulemaking (NPRM) seeking reply comment on the above referenced proceeding.²

In these reply comments, V-COMM addresses technical issues associated with the comments filed within the FCC’s Interference Temperature proceeding and considers the potential for harmful interference to Commercial Mobile Radio Service (CMRS) networks that could be caused by sharing CMRS spectrum bands with unlicensed devices.

¹ V-COMM, L.L.C. is a wireless telecommunications consulting company with principal members having over 20 years experience in the wireless industry. We have provided our expertise to wireless operators in RF engineering, system design, implementation, performance, optimization, and evaluation of new wireless technologies. We have extensive industry experience in all CMRS technologies. V-COMM’s company information and experiences are highlighted in this report’s Appendix A, along with biographies of senior members of its engineering team.

² *Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Bands*, ET Docket 03-237, Notice of Inquiry and Notice of Proposed Rulemaking, ET Docket 03-237 (released November 28, 2003) (“*Interference Temperature NOI*” or “*Interference Temperature NPRM*”). All references to other parties’ comments were filed in this proceeding on April 5, 2004.

V-COMM is an independent engineering firm with extensive expertise in CMRS technologies and systems. Through extensive testing and engineering experience, V-COMM has gained valuable insight to the compatibility issues associated with spectrum-sharing technologies and the technologies and systems operating within CMRS spectrum. V-COMM has conducted extensive interference and compatibility tests with spectrum-sharing technologies within cellular spectrum,³ and has performed extensive noise and interference studies in cellular and PCS spectrum,⁴ and documented these results for consideration by the Commission.

Pursuant to a contract with Verizon Wireless, V-COMM has reviewed comments submitted within the FCC's Interference Temperature proceeding, and prepared the following reply comments for submission in the docket. The report addresses the comments filed in the FCC's Interference Temperature proceeding, and provides a review of the technical issues both in opposition to and in favor of the FCC's Interference Temperature concept. V-COMM demonstrates that there are commonalities among the conclusions of many of comments submitted in opposition to the Interference Temperature concept. In addition our analysis exposes the serious technical flaws of the Shared Spectrum, Hypres and Agilent comments that support of the Commission's Interference Temperature proposals as well as these parties' alternative proposals. We also include a review of the potential impacts of this proposal on

³ V-COMM has conducted extensive compatibility and interference tests within AT&T Wireless, Cingular, and Verizon Wireless' cellular and PCS networks. In the FCC's AirCell proceeding (ET 02-86), V-COMM has submitted comprehensive engineering reports, filed on April 10, 2003.

⁴ V-COMM has conducted spectrum noise and interference measurements within Cingular and Verizon Wireless cellular and PCS networks. V-COMM submitted the "AMPS Noise Floor Study" within the FCC's AirCell spectrum-sharing proceeding (ET 02-86) on April 10, 2003, and the "PCS Noise Floor Study" within the FCC's Spectrum Policy Task Force Report proceeding (ET 02-135) on Sept. 16, 2003. These spectrum noise studies were also provided as Attachment B and Attachment C to Comments filed by V-COMM in the FCC's Interference Temperature (ET 03-237) comment proceeding on April 5, 2004.

CMRS networks and problems that the Commission would create by applying the Interference Temperature concept to the Fixed Service (FS) microwave spectrum bands (6 GHz).

I. DISCUSSION AND SUMMARY

The vast majority of comments submitted by the wireless industry, including carriers, equipment vendors, industry associations, standards groups, government entities, and other parties, oppose the FCC's proposed Interference Temperature (ITEMP) concept. Parties believe that the proposed ITEMPP concept is not a workable, practical or feasible solution to improve the use of licensed radio spectrum, nor will it prevent harmful interference to licensed spectrum users. A number of parties, including licensees, equipment vendors, industry groups, and others, cite specific losses in services and reductions in spectrum efficiencies that can occur as a result of unlicensed ITEMPP applications in licensed spectrum bands. Based upon the overwhelming response from the industry, the ITEMPP concept has many inherent and unresolved problems, and it would not be sound spectrum policy to rely upon such flawed, unproven concepts to manage licensed spectrum bands.

On the other hand, only three parties, Shared Spectrum, Hypres and Agilent offer any support of the ITEMPP concept as a means to enable unlicensed devices to share licensed spectrum bands. However, their proposals are not based upon sound reasoning and engineering principles, and in some cases appear to be motivated by self-serving interests, such as allowing their technology free access to valuable licensed spectrum bands. Their proposals contain numerous technical flaws and many unresolved issues that will not protect incumbent licensed networks from harmful interference. These issues are examined in Section V below.

In particular, many commenters provided sound technical reasons why CMRS bands are particularly ill-suited for unlicensed ITEMP applications. These include:

- CMRS network and subscriber equipment are very sensitive to incremental increases in the noise floor from external sources,
- CMRS networks have very high density and mobility of users,
- CMRS networks utilize many different wireless technologies,
- CMRS licensees were granted sufficient regulatory flexibility to allow them to optimize spectrum use and efficiency.

Even three vocal advocates of increasing unlicensed spectrum use, the IEEE 802.11 group, the WI-FI Alliance group, and Proxim, agree that there are difficulties in applying the ITEMP concept to licensed spectrum bands with high density and mobility of users.⁵

Based on these reasons, the FCC should not authorize unlicensed ITEMP applications in CMRS bands, or other licensed bands with similar characteristics. Authorizing unlicensed ITEMP devices in CMRS bands will cause serious detrimental harm to services provided by these networks. The impacts to CMRS networks are studied and provided by a number of parties providing comments in this proceeding including AT&T Wireless, Sprint-Telcordia, Motorola, Lucent and V-COMM. All parties show severe detrimental impacts to CMRS networks. When faced with the additional interference from unlicensed devices, CMRS providers must either overbuild their networks to mitigate the effects of the external interference, or provide poorer service to their customers and accept reductions in system coverage and capacity. As given by

⁵ We note that the FCC's Spectrum Policy Task Force (SPTF) report also expressed reservations about the application of this concept to mobile bands, given the difficulties outlined on Page 4 of the SPTF report.

all parties' network impact studies, the harmful impacts to CMRS networks are considerable and the costs to overbuild their networks equally high.

Furthermore, the Commission should take note of Sprint and Telcordia's conclusions regarding sharing licensed CMRS bands with unlicensed ITEMP devices results in an overall reduction in spectrum efficiency, which runs contrary to the objectives of the Commission to improve the use of radio spectrum.

Lastly, most parties remind the FCC that it should support and strengthen rather than abandon its long-standing neutral position on technology. The Commission should allow market forces to decide and influence technology-based solutions, rather than mandate protocols for an ITEMP application.

II. MOST PARTIES OPPOSE THE COMMISSION'S ITEMP CONCEPT IN CONCEPT AND IN PRACTICE

The vast majority of comments submitted on behalf of the wireless industry, including carriers, equipment vendors, industry associations, standards groups, government entities and other parties, oppose the FCC's proposed ITEMP concept. These parties provide technical information to demonstrate that the ITEMP concept it is not a workable, practical or feasible means to improve the use of licensed radio spectrum, nor will it prevent harmful interference to licensed spectrum users. A number of parties, including licensees, equipment vendors, and industry associations, cite specific losses in services and reductions in spectrum efficiencies that can occur as a result of unlicensed ITEMP applications in licensed spectrum bands. Based upon the overwhelming response from the industry, the ITEMP concept has many inherent and

unresolved problems, and it would not be sound spectrum policy to rely upon such flawed, unproven concepts to manage licensed spectrum bands.

Wireless carriers, such as AT&T Wireless, raise concerns about the deployment of the ITEMP concept: “If an interference temperature limit were established in the CMRS bands, wireless customers would experience reductions in coverage, capacity, and overall service quality.”⁶ Verizon Wireless submits that:

The proposal is based on faulty engineering theories that, if implemented, would seriously impede the efficient use of spectrum by current geographic based, exclusive use licensees and undermine consumer welfare to the tune of billions of dollars.⁷

Cingular Wireless raises issues relative to current unlicensed devices and their ability to coexist in their own bands let alone licensed bands. Cingular questions “If the un-licensed devices cannot coexist with themselves then why is it expected that they will coexist successfully in licensed bands?”⁸ Addressing the coexistence of unlicensed devices in unlicensed bands and their incompatibility with licensed CDMA bands, Qualcomm adds:

The proposed interference temperature metric, with further study and refinement, may be useful in unlicensed bands where there are not strong incentives for efficient use due to the shared nature of the bands and where additional unlicensed operations would be compatible with the existing uses of the bands. However, QUALCOMM does not support the imposition of the new interference metric, which is designed to enable greater unlicensed operations, in licensed bands. QUALCOMM shows herein that even what the Commission considers a slight increase in the noise temperature in a licensed band would substantially impair the service provided by licensees who have deployed Code Division Multiple Access (“CDMA”) technology, resulting in a

⁶ AT&T Wireless Comments on page 1.

⁷ Verizon Wireless Comments on page 2.

⁸ Cingular Wireless Comments on page 56.

substantially reduced coverage area of each cell and a decreased battery life in each wireless phone.⁹

Lastly, relative to the impact of deploying an ITEMP concept on licensed bands, Motorola concludes: “Given the technical difficulties in implementing an interference temperature, and the potentially severe consequences on existing services, Motorola respectfully urges the Commission not to proceed with implementation of interference temperature concept at this time.”¹⁰

In addition, parties including V-COMM, Globalstar, ICO Global Communications, Inmarsat and others (collectively “Satellite Companies”) submitted comments strongly advising the Commission that its current definition of harmful interference is not sufficient to protect services offered in licensed spectrum bands, and is not appropriate to use in conjunction with sharing such bands with unlicensed ITEMP applications. The Satellite Companies state:

Clearly harmful interference cannot be used as a standard for authorizing new users under an interference temperature approach. Harmful interference is an extreme level of interference that “seriously degrades, obstructs or repeatedly disrupts” the operations of a communications system...

As Commissioner Copps observes in his separate statement: While the interference temperature metric may be a good new way to measure interference, we do not have an adequate way to determine what the right interference temperature is for a given band. The only tools we have for this job are the ill-fitting and ill-defined “interference” and “harmful interference” concepts. The inappropriateness and inadequacy of these concepts for the job of prospectively setting interference temperature will make this new metric very hard to use predictably and non-arbitrarily in the real world.¹¹

⁹ Qualcomm Comments, on an unnumbered page, preceding page ii.

¹⁰ Motorola Comments on page 17.

¹¹ Satellite Companies Comments on page 9-10 (footnotes omitted).

The Commission should recognize that CMRS spectrum is particularly ill-suited for unlicensed ITEMP applications, for a number of reasons. Included, are the network equipment's sensitivity to incremental increases in the noise floor from external sources, the very high density and mobility of users, the many different wireless technologies deployed, and the regulatory flexibility offered in these bands to optimize spectrum use and efficiency. Many parties to this proceeding are in agreement with the assessment that there are difficulties in applying the ITEMP concept to licensed spectrum bands, including three parties that advocate increasing unlicensed spectrum use. These include the IEEE 802.11 group, the WI-FI Alliance group, and Proxim.

IEEE states:

We also believe that some spectrum segments, like mobile bands including public safety, deserve special protection from interference and should not be considered for unlicensed use on the basis of the interference temperature concept.¹²

Proxim concludes:

... the Interference Temperature concept, in which devices make local measurements that determine the transmit/no-transmit decision, is fraught with difficulty. The main problems are ... [first item] Local measurements made by a sharing device cannot determine accurately whether or not such a device will cause harmful interference to a licensed subscriber.¹³

WI-FI Alliance also submitted opposing comments on the ITEMP concepts:

... the Alliance has concluded that the proposed "interference temperature" metric will not be broadly practical and applicable, and respectfully submits that the high level objective of increased spectrum efficiency and access to spectrum may be met through the use of other techniques ...

¹² IEEE Comments on page 28.

¹³ Proxim Comments, in Conclusion section.

... local propagation conditions vary so much that measuring the noise level at any given point does not provide reliable information about the observed noise level at a nearby point.

This [ITEMP] would, in turn have profound impact on equipment design and cost, leading to increased outlays by operators and individual users alike. Operational consequences would include much higher demands on network management resources and therefore higher operating costs.¹⁴

Even the FCC's Spectrum Policy Task Force (SPTF) report indicates that greater density and mobility raise problems with respect to the application of ITEMP:

Interference management has become more difficult because of the greater density, mobility and variability of radio frequency (RF) emitters. Interference management becomes even more problematic when and if users have been granted increased flexibility in their spectrum use. As a result, the complexity of predictive interference models has increased dramatically, and is expected to increase even more in the future.¹⁵

It is obvious that the Commission should not authorize unlicensed ITEMP applications in CMRS bands, or other licensed bands with similar characteristics. Authorizing unlicensed ITEMP devices in CMRS bands will cause serious detrimental harm to services provided by these networks.

The impacts to CMRS networks are studied and provided by a number of parties providing comments in this proceeding including AT&T Wireless, Sprint-Telcordia, Motorola, Lucent and V-COMM; with all parties showing severe detrimental impacts to CMRS networks. When faced with the additional interference from unlicensed devices, CMRS providers must either overbuild their networks to mitigate the effects of the new sources of interference, or provide poorer service to their customers and accept reductions in system coverage and capacity.

¹⁴ Wi-Fi Alliance Comments in paragraphs 7-8, and Introduction section.

¹⁵ FCC *Spectrum Policy Task Force Report* (ET 02-135), Nov. 2002, on page 4.

As given by all parties' network impact studies, the harmful impacts to CMRS networks are considerable and the costs to overbuild their networks are equally high.

For example, the impact to CMRS networks under a 3 dB increase in total cumulative noise from external interference, V-COMM concluded that system coverage decreases by a significant 32% to 38% (for rural to urban areas), and the capacity of a CDMA system can decrease by as much as 61%.¹⁶ Similarly, Lucent Technologies, for a 3 dB increase in total noise, estimates a 30% loss in coverage, and 82% loss in capacity for an IS95 CDMA system.¹⁷ AT&T Wireless, for a 2 dB increase in total noise, estimates a 25% loss in system coverage, and 40% loss in capacity for GSM system.¹⁸ Motorola, and Sprint-Telcordia, show a reduction in CDMA capacity of 33%, for the 3 dB increase in total cumulative noise case.¹⁹

Accordingly, the impacts to CMRS networks are undeniably clear; all parties showing severe detrimental impacts to CMRS networks, to accommodate the additional interference from unlicensed devices.²⁰ Also, even under seemingly low levels of increased interference from external sources, CMRS networks can be expected to suffer substantial losses in performance.²¹

¹⁶ V-COMM Comments on page 56. V-COMM considered the loss in capacity of a CDMA system supporting IS95 and 3G-1x traffic in equal proportions.

¹⁷ Lucent Comments on pages 3 and 10. Lucent considered the loss in capacity of a CDMA system supporting IS95 (8 kbps EVRC) traffic.

¹⁸ AT&T Wireless Comments on pages 17-18. AWS considered the loss in capacity of a GSM cellular/PCS system.

¹⁹ Motorola Comments on page A-2, and Sprint's Comments on page 16. Motorola considered the loss in capacity of UTMIS Wide-band CDMA (5 MHz BW) system.

²⁰ All parties show significant impacts to network coverage with similar assumptions for propagation loss characteristics, and similarly severe impacts for network capacity losses, which are dependent on the particular technology and network parameters employed by the licensed CMRS operator.

²¹ Lucent Comments on page 11 state "[i]n all cases, the degradation of performance in the presence of external interference can be significant." V-COMM's Comments at pages 55-58.

In addition to the significant harmful impacts to CMRS networks, the costs to overbuild their networks can be expected to be equally significant.²²

In addition, the Commission should take note of Sprint and Telcordia's comments regarding sharing licensed CMRS bands with unlicensed ITEM devices results in *overall reduced spectrum efficiency*, which runs contrary to the objectives of the Commission to improve the utility of radio spectrum. Sprint states:

...Telcordia analysis makes clear that raising the noise floor by adding interference to a CDMA base station results in a reduction in licensed spectrum capacity, which, in turn, represents a net loss in spectral efficiency (with respect to the data throughput capacity gained by unlicensed devices in the band).²³

In addition, it is important to recognize that the spectrum efficiency in CMRS bands have increased considerably over the past 20 years, as a result of market forces and increased subscriber demands. Lucent describes this trend, and states the following:

The highly competitive CMRS market has supported the deployment of increasingly more efficient radio technologies...

... the spectral efficiency of CMRS technology has increased 30 times relative to that provided by the original analog AMPS systems. Accordingly, the Commission need not look to the use of unlicensed devices as a means to improve the spectral efficiency of the technologies used in the CMRS bands.²⁴

²² In V-COMM Comments at page 56-59, it estimated that to overcome the additional interference equal to the noise floor, a nationwide CDMA service provider would require 1.5 times the number of base stations for coverage, and 2.5 times the number of base stations for capacity, translating into as much as a 390% increase in total operating network costs.

²³ Sprint Comments on page 31. Sprint further explains the net loss in spectrum efficiency in its comments submitted in this proceeding at pages 19 to 21.

²⁴ Lucent Comments at page 5.

III. THE COMMISSION SHOULD NOT IMPLEMENT ITEMP IN THE FIXED SERVICE MICROWAVE BANDS

V-COMM agrees with comments that oppose the Commission's proposal to experiment with ITEMP in the Fixed Service (FS) microwave spectrum at 6 GHz.²⁵ Several commenters suggest that this would cause harmful interference to incumbent licensed point to point links,²⁶ and it does not address many real-world situations. Also, the *Interference Temperature NPRM* does not address how to resolve or remove unlicensed ITEMP devices should harmful interference occur in these bands.

The NPRM does not consider many practical and real-world situations that can cause harmful interference to incumbent microwave systems. Under an unlicensed ITEMP scenario nothing restricts unlicensed usage locations. An unlicensed device is likely to be portable, and in some cases moving, therefore its location cannot be presumed to be always greater than 100 meters and outside the main beam of victim microwave antennas.²⁷ In many cases the unlicensed device could operate within the main beam of the victim microwave antennas, and cause harmful interference to the licensed service, even when located up to 24 km away. FWCC submitted the comments:

For unlicensed devices in the boresight, even great distances offer inadequate protection. Using a specific FS link in Phoenix, AZ, we show that a single one-watt emitter anywhere in a square-kilometer-plus area in central Phoenix will exceed the acceptable

²⁵ Comsearch, Fixed Wireless Communications Coalition, Shared Spectrum (an unlicensed ITEMP proponent), and other parties expressed reservations and practical difficulties associated with the Commission's *NPRM* in the FS microwave bands.

²⁶ Comsearch Comments on page ii, "... we believe it [NPRM] will cause harmful interference to fixed service receivers." FWCC Comments on page 21, "... neither directivity nor distance can adequately protect FS receivers from interference caused by unlicensed devices on their frequencies."

²⁷ In the *NPRM*, these two assumptions are considered by the FCC with regards to the potential interference to incumbent microwave systems.

interference threshold hundreds of times over at an FS receiver on Thompson Peak, 24 km away.²⁸

Unlicensed devices operating outside the main beam, can also cause harmful interference as well, as commented by FWCC:

Under realistic scenarios, we show that a single unlicensed emitter 100 meters from an FS receiver, and well outside the boresight, will cause interference if its power level exceeds 3 thousandths of a watt -- far below the 1 to 4 watts contemplated by the Commission for unlicensed transmitters in these bands.²⁹

In addition, the NPRM does not consider the effects of increased system outages³⁰ that can occur when unlicensed ITEMP devices increase the noise levels in-band and decrease the remaining margins for microwave incumbents to operate. Microwave systems can be very sensitive to increases in noise, as they use very sensitive receivers³¹ operating in thermal noise-limited spectrum and with carefully designed point to point links. Comsearch states the following:

FS receivers are almost always noise limited. Because of the careful frequency planning and coordination used to select the FS link parameters (frequency, polarization, power, etc.), widespread noise floor degradation does not occur in the 6.7 and 13 GHz bands. Therefore engineers can depend on operation down to the receiver's data sheet threshold as they design links.

The Report of the Second Meeting of the FCC Technological Advisory Council III states: Investigators also found that classical man-made noise from machinery and ignition systems was generally not observable above 500 MHz.³²

²⁸ FWCC Comments at page 3.

²⁹ *Id.*, at page 2.

³⁰ Comsearch Comments on page 15: "the interference of the unlicensed device would take nearly all the fade margin of the FS receiver and reduce the link reliability from 99.9999% to 96%."

³¹ FWCC Comments on page 21.

³² Comsearch Comments on page 6.

FWCC commented:

FS communications are subject to high levels of atmospheric fading. To maintain the availability needed for critical services, FS manufacturers routinely select transmitter power and antenna gain so as to build in enough fade margin to overcome fading and ensure the link remains available for service under worst-case conditions.³³

In conclusion, regarding unlicensed ITEMP applications in microwave bands, the Commission should not move forward with its NPRM because its current proposal will not protect incumbent licensed systems from harmful interference. The IEEE 802 group (an advocate of unlicensed users) also agrees that “FS operations may not have been fully examined” in this respect, and recommends not moving forward without “further analysis of the impact on FS systems.”³⁴

IV. THE COMMISSION SHOULD NOT ABANDON ITS LONGSTANDING POLICES TO ENCOURAGE FLEXIBLE USE OF LICENSES

Lastly, as provided by AT&T Wireless,³⁵ Verizon Wireless³⁶ and other parties, it is important for the FCC to reaffirm rather than abandon its long-standing neutral position on technology and allow market forces to decide and influence technology-based solutions, rather than the government mandating protocols for an ITEMP application. Government mandated protocols are examples of “command and control” regulatory structure, which does not agree with the SPTF’s proposals to minimize reliance on such regulatory approaches to spectrum

³³ FWCC Comments at Page 6.

³⁴ IEEE 802.11 Comments at paragraphs 23-24.

³⁵ AT&T Wireless Comments at pages 3-4 state: “The forces of a competitive marketplace are already ensuring that CMRS spectrum is used efficiently and are driving ever more intensive use of this limited resource.”

³⁶ Verizon Wireless’ Comments at page 17.

management.³⁷ Instead, the FCC should rely upon market forces, increased flexibility and secondary market arrangements to optimize licensed spectrum use, and allow technology innovations to continue to occur in these bands.

Verizon Wireless supports this position to reaffirm licensee rights and flexibility, and states:

Instead, it [FCC] should reaffirm rather than abandon its long-established policy of giving licensees exclusive and flexible use of their spectrum, and refocus its efforts on further clarifying and strengthening those rights. This course will promote the public interest goals of efficient spectrum use that best serves customers.³⁸

The FCC's SPTF agrees with this assertion, as stated under the title "Common Elements of Spectrum Policy" within its report:

...there are certain common elements that the Commission should incorporate into its spectrum policy regardless of the regulatory model that is used.

- Maximum feasible flexibility of spectrum use by both licensed and unlicensed users.
- Clear and exhaustive definition of spectrum users' rights and responsibilities.³⁹

Market forces are more suited than the Commission's rule making process to weigh the costs and benefits of new technologies to improve the use of radio spectrum. These forces have worked to evolve radio communications and services over the past decades and will continue to do so without government intervention. To optimize spectrum use, the FCC should seek to

³⁷ In the FCC's SPTF report (ET 02-135) Nov. 2002, on page 5, Task Force states that "the Command-and-control regulation should be reserved only for situations where prescribing spectrum use by regulation is necessary to accomplish important public interest objectives or to conform to treaty obligations."

³⁸ Verizon Wireless Comments at page 1.

³⁹ FCC's SPTF report (ET 02-135, Nov. 2002), Page 4.

minimize regulatory involvement and to allow incumbent licensees to maximize the use and benefits derived from spectrum through deployments of innovative technologies and methods that meet the needs of the markets.⁴⁰ Incumbent licensees can continue to manage and improve spectrum efficiencies, and at the same time allow additional access into their bands through increased licensee flexibility and secondary market arrangements.

Interference Temperature and other spectrum-sharing alternatives will require substantially more intervention from the Commission to address, outline, enforce, and resolve ongoing interference issues with existing and future licensed carriers. Further, such spectrum sharing applications may lead to uncontrollable interference environments in licensed bands, which are impossible to track, police, control or resolve interference that occurs after the fact. These tasks should not be underestimated and can be expected to be quite extensive.

V. THERE ARE MAJOR FLAWS IN ARGUMENTS OF PARTIES SUPPORTING THE ITEMPT CONCEPT

The proponents of the ITEMPT concept are in the extreme minority of the comments submitted in this proceeding. Comments from Shared Spectrum, Hypres and Agilent are supportive of the ITEMPT concept as a means to enable unlicensed devices to share licensed spectrum bands.⁴¹ However, their proposals are not based upon sound reasoning and engineering principles, and in some cases appear to be motivated by self-serving interests,⁴² such as allowing

⁴⁰ The Satellite Companies on page 9 state “[i]ncreasing spectrum users through implementation of a set interference temperature limit will unavoidably constrain the future growth and development of existing users, likely condemning them to eventual obsolescence.”, and the comment that “In effect, such rules would impose a technology freeze on satellite system operators, handcuffing them to outdated equipment and techniques.”

⁴¹ Shared Spectrum, Hypres and Agilent submitted comments in this proceeding on April 5, 2004.

⁴² Hypres Comments on 8 state: “[w]e urge the Commission to take the increased performance available with SME [their technology] into account when considering proposed rules.”

their technology free access to valuable licensed spectrum bands. Their proposals contain numerous technical flaws and many unresolved issues that will not protect incumbent licensed networks from harmful interference. These issues are explained below.

Shared Spectrum. Shared Spectrum supports the ITEMP concept to share licensed spectrum bands with unlicensed devices, and provides that its “Open Loop Architecture” is a practical and workable approach to achieve efficient spectrum access. Below, V-COMM addresses the technical flaws associated with Shared Spectrum’s proposals, including its ability to prevent harmful interference to incumbents, inability to properly estimate path loss and other network parameters, does not take into account other factors including multiple users, and interference mitigation and resolution.

Shared Spectrum claims that its proposed ITEMP “Open Loop Architecture” “is a practical approach that is widely applicable.”⁴³ This approach proposes to measure the licensed system's "primary signal levels" as received at the unlicensed device, and approximate the victim transmitter power levels, to estimate the "path loss" from the victim licensed transmitter to the unlicensed device. Then, it uses this calculated path loss in conjunction with an ITEMP limit for a particular band, and computes the maximum allowable transmit power for unlicensed devices at any particular moment in time and for all frequencies in a licensed spectrum band.

The proposed method is not practical, it contains many flaws, and will not prevent harmful interference to incumbent licensed systems. The method relies upon the faulty assumption that an unlicensed device can properly estimate path loss from a victim transceiver to an unlicensed device without taking into account many factors which will prevent the proper assessment of this path loss. These factors include:

1.) The transmit power level of the licensed transmitters are unknown and change from time to time. Operators modify transmit power settings with system optimizations and new network deployments. Also, transmit power levels vary across the day according to network loading conditions, and vary over time according to levels needed to serve mobile phones.

2.) The unlicensed device can only measure the forward frequency band (base to end user) at its location, and the reverse path (end user to base) is operating on a different paired frequency band. This can lead to incorrect assessments of path loss using different (Tx vs. Rx) frequency bands and different (Tx vs. Rx) physical antennas, with different propagation and multi-path fading characteristics which can vary the received signal levels by more than 20 dB.

3.) This approach cannot assess whether the ITEMP limit is already reached at the incumbent licensed system. It does not attempt to measure the real-time noise environment, which is the FCC's ITEMP concept, much less measure the cumulative contributions of a licensed system's internal noise, and external noise from other ITEMP and UWB devices.

4.) It does not address differences in radio equipment characteristics including operating receiver bandwidths, noise figures, and other equipment parameters.

5.) It cannot determine the number of unlicensed devices transmitting in any particular area. Since this is an unknown, it prevents the proper assessment of available transmit power for an unlicensed device on any spectrum band.

Consequently, Shared Spectrum's proposed method will not appropriately estimate path loss (or other network parameters), will lead to many erroneous assessments, and has the potential to cause substantial harmful interference to incumbent licensed systems. In addition,

⁴³ Shared Spectrum Comments on pages 6-9.

the proposed approach does not protect licensee's equipment having more sensitive receivers than those with "typical" noise figures, and precludes licensees from deploying improved and advanced technologies that better utilize signals closer to the noise floor. Therefore, it would be inappropriate for the Commission to adopt Shared Spectrum's open loop ITEMP approach. Also, the proposed approach does not address any regulatory enforcement issues, methods to address rogue unlicensed devices, or issues involved with interference control, management and resolution, should harmful interference occur.

Comments submitted by Motorola agree with the practical difficulties involved in an open loop ITEMP proposal:

The secondary device has little or no knowledge of the difference in propagation conditions between the two locations (assuming it knows the locations), and cannot know what kind of path losses its transmissions would experience. Nor could it know if another secondary user is already transmitting elsewhere and causing interference to the incumbent primary user, but whose contributions are not measurable at the secondary unit in question.⁴⁴

V-COMM also disagrees with Shared Spectrum's ITEMP limit proposal,⁴⁵ and believes it would cause serious harm if applied to licensed CMRS bands. Shared Spectrum advocates an ITEMP limit at 3 dB below a typical receiver's noise figure operating in the band, and does not consider the serious potential impacts or costs associated with its proposed limit, but states that "[t]he 3 dB value provides a balance between the impact to the Affected Receiver [victim] and ability of the Transceiver [unlicensed device] to transmit reasonable power levels."⁴⁶ V-COMM disagrees with Shared Spectrum's proposed limit and assessment. It should not be based on the

⁴⁴ Motorola Comments on pages 13-14.

⁴⁵ Shared Spectrum Comments on pages 13-16.

⁴⁶ *Id.* on page 13.

utilization of reasonably (higher) transmit power levels to sustain better performance for unlicensed opportunistic uses of licensed spectrum bands.

In addition, if this ITEMP limit were applied to CMRS spectrum bands, serious harmful interference would occur in these licensed bands. This proposed ITEMP limit would increase the total cumulative noise in the band by 1.764 dB, or a 50% increase in noise level. For a CMRS network using CDMA technology, this translates to a reduction in system capacity of 30%, a reduction in system coverage of 21 to 24% (for urban to rural areas), and overbuild requirements as much as 1.4 times the number of base stations to maintain existing service.⁴⁷ Further, for a hypothetical nationwide CDMA network (as described in Section VI of V-COMM's Comments), this translates to a 130% increase in total network operating costs required to maintain existing CMRS service levels. Therefore, Shared Spectrum's proposed ITEMP limit is inappropriately high, and should not be applied to CMRS spectrum else it will cause serious detrimental effects to these licensed systems.

V-COMM also believes the proposed ITEMP limit is inappropriately high for other bands as well, and prior to adopting any ITEMP limit the FCC must carefully consider the serious potential impacts and costs associated with such spectrum sharing proposals in licensed spectrum bands.

Hypres. V-COMM examines the ITEMP proposals of Hypres, a second ITEMP proponent submitting comments in this proceeding. Hypres is supportive of the ITEMP concept as means to enable unlicensed devices to share licensed spectrum bands through the use of

⁴⁷ For additional information on the Network Impact Study for Cellular and PCS Systems, refer to Section VI of V-COMM's Comments.

existing base stations as monitoring and management stations. However, its proposal is not based upon sound reasoning and engineering principles.

Comments provided by Hypres outline a proposed methodology to the FCC that leaves many unanswered questions, as well as making broad and unsupported assumptions. Hypres describes its Superconductor MicroElectronics (SME) technology as an efficient technology, and suggests their technology can be utilized by the FCC to implement the ITEMP concept. While V-COMM agrees superconductor technology is an efficient technology, V-COMM disagrees with the latter assessment because this technology has not proven to be cost effective as evidenced by the low deployment rate in commercial radio systems. Additionally, while Hypres suggests the FCC utilize its SME technology as part of the solution, it does not outline the specifics on how its technology can be deployed to provide direct benefits in addressing the ITEMP concept.

In its comments, Hypres suggests a new concept, the Spectrum Segment Manager (SSM), analogous to a trunked radio controller, could be deployed to keep track of historical baseline information for a given geographical area. It proposes that existing licensees' base stations are utilized as the monitoring sources for the SSM, and will ultimately assist in interference mitigation, as well. Finally, without analyzing of the potential impact to incumbent systems, Hypres opines that the adoption of their plan will have no impact on existing equipment or services. V-COMM questions the validity of these assessments. Hypres provides no technical or engineering analysis of the impact to incumbent systems in connection with its proposed approach. Even Shared Spectrum (a proponent of the ITEMP concept) offers reservations concerning the practicality of the network monitoring approach:

Because of the limited applicability and the practical difficulties
(cost of the Monitoring Sites, getting the data back to the

Transceiver, and calibrating the Monitoring Sites), we believe that the Closed-Loop architecture is workable in only a few scenarios, and should not be the basis for using the Interference Temperature concept.⁴⁸

In addition, Motorola outlines the practical difficulties with reliable network monitoring solutions:

Unfortunately, the only reliable way to measure a true noise floor without considering the contributions of primary services is to command every primary transmitter to be silenced. Only then could the noise floor be accurately measured, since only natural and unintentional man-made emissions would be present.

Of course, the consequence of such a shut down of incumbent operations is the loss of revenue or services to commercial operations or the disruption of other critical, private communications. These consequences are clearly unacceptable.⁴⁹

Sprint also disagrees with the network monitoring approach and states “[t]he “direct” interference control mechanism might be workable in theory, but would involve so many technical, engineering and cost challenges that the approach is not feasible as a practical matter.”⁵⁰ Hypres does not begin to delineate what will be involved in the actual development of the SSM concept, including the R&D costs, the interconnection to the various deployed systems, spectrum requirements for communicating to the ITEMP devices, nor the potential harmful impacts to incumbent licensed systems, services and subscribers.

Agilent. Lastly, V-COMM examines the ITEMP proposals of Agilent, a third ITEMP proponent submitting comments in this proceeding. Agilent is supportive of the ITEMP concept in an approach similar to what Hypres proposed (through the use of existing base stations as monitoring stations) and includes incorporating internet connections with frequency servers.

⁴⁸ Shared Spectrum Comments on page 6.

⁴⁹ Motorola Comments on pages 8 and 9.

Agilent comments that “a workable, cost effective solution can be created by combining the interference temperature concept with the concept of frequency servers.”⁵¹ However, its proposal does not address the potential harmful impacts to incumbent licensed systems, and does not contain technical or sound reasoning as a basis for its proposals.

In its comments, without any analysis, Agilent presumes the ITEMP concept is a “practical and cost-effective to implement.”⁵² It assumes an interference temperature metric could be monitored by base stations and established by using “frequency servers” (computers) on the internet. With its ITEMP proposal, Agilent does not offer any specific or sound engineering justification to support the ITEMP concept, or its concept of frequency servers. The only justification offered by Agilent are extraneous references to “social, political and economic progress” which is made (it claims) based upon compromises that begin with uncertain practicality.⁵³

In addition, Agilent offers specific *deficiencies* in the ITEMP concept that the Commission should recognize concerning a licensee’s ability to meet increased capacity needs in the future:

All current license holders must deal with the unstoppable trend of ever increasing data capacity requirements. Therefore, while it may be possible to establish an interference temperature threshold, this presumes that current license holders will never desire to improve system throughput. Unless the interference temperature threshold can be adjusted, a successful implementation of interference

⁵⁰ Sprint Comments on page 32.

⁵¹ Agilent Comments on pages 4-5.

⁵² *Id.* on page 2.

⁵³ *Id.* on page 3.

temperature concept could preclude the primary user from increasing system capacity.⁵⁴

Agilent primarily focuses its proposal with respect to applications in the FSS band, while noting complexities associated in other bands.⁵⁵ In its approach, Agilent suggests the satellites operating in the Fixed Satellite Service (FSS) bands would “periodically report to the server the observed interference temperature.”⁵⁶ However, Agilent does not address the practicalities of its proposal, such as the implementation issues, the technical feasibility of satellites being modified to provide these new monitoring functions, the management requirements of its proposed system of frequency servers, or the impact or costs to the incumbent licensed satellite systems.

V-COMM concludes that the ITEMP comments submitted by the ITEMP proponents Shared Spectrum, Hypres and Agilent are not based upon sound reasoning and engineering principles. Their proposals contain numerous technical flaws and many unresolved issues that will not protect incumbent licensed networks from harmful interference. Furthermore, the parties’ comments do not even begin to address the multitude of issues and major technical flaws of the proposed ITEMP concept as addressed by V-COMM in its comments submitted in this proceeding,⁵⁷ including the impact to incumbent licensed systems as a result of increasing noise floors and reducing operating margins; loss in incumbent services (i.e. CMRS voice, data, or E911 determinations); effects of non-similar receiver characteristics and monitoring locations, distinguishing “primary signals” from interference plus noise, or other external unlicensed noise;

⁵⁴ *Id.*

⁵⁵ Agilent Comments on pages 4-5 provide the following concerning ITEMP applications in FS Microwave bands “For this reason, it is difficult to envision a system based on the interference temperature alone that would efficiently share spectrum with a secondary user while maintaining high reliability in the primary service.”

⁵⁶ Agilent Comments on page 7.

⁵⁷ Section IV of V-COMM Comments.

ever-increasing noise floor conditions; overall spectrum efficiency; costs to incumbents to overbuild networks to maintain services; value of spectrum; impact on incumbent's willingness to deploy and invest in innovative and advanced technologies; the harm to licensed bands would be permanent, since unlicensed devices cannot be controlled or managed once they are in mass-market circulation; and they will not prevent harmful interference from occurring to incumbent licensed systems.

VI. CONCLUSION

For the provided reasons, V-COMM respectfully requests the Commission to thoroughly review the significant deficiencies in the proposed Interference Temperature concepts and the compatibility issues involved in sharing licensed spectrum bands with unlicensed uses. The Commission must carefully consider the effects of new spectrum-sharing services on increasing spectrum noise floors and causing harmful interference to existing licensed communication services. The Commission's objective to increase and improve the use of radio spectrum is best met by protecting licensed communication services from the effects of harmful interference.

Respectfully Submitted,

V-COMM, L.L.C.

Sean Haynberg,
Director of RF Technologies
David Stern, Vice President
Dominic Villecco, President
3 Cedar Brook Drive
Cranbury, NJ 08512
(609) 655-1200

May 5, 2004

APPENDIX A – COMPANY INFORMATION & BIOGRAPHIES

V-COMM is a leading provider of quality engineering and engineering related services to the worldwide wireless telecommunications industry. V-COMM's staff of engineers are experienced in Cellular, Personal Communications Services (PCS), Enhanced Specialized Mobile Radio (ESMR), Paging, Wireless Data, Microwave, Signaling System 7, and Local Exchange Switching Networks. We have provided our expertise to wireless operators in engineering, system design, implementation, performance, optimization, and evaluation of new wireless technologies. Further, V-COMM was selected by the FCC & Department of Justice to provide expert analysis and testimony in the NextWave and Pocket Communications Bankruptcy cases. V-COMM has offices in Blue Bell, PA and Cranbury, NJ and provides services to both domestic and international markets. For additional information, please visit V-COMM's web site at www.vcomm-eng.com.

BIOGRAPHIES OF KEY INDIVIDUALS

**Dominic C. Villecco
President and Founder
V-COMM, L.L.C.**

Dominic Villecco, President and founder of V-COMM, is a pioneer in wireless telecommunications engineering, with 22 years of executive-level experience and various engineering management positions. Under his leadership, V-COMM has grown from a start-up venture in 1996 to a highly respected full-service consulting telecommunications engineering firm.

In managing V-COMM's growth, Mr. Villecco has overseen expansion of the company's portfolio of consulting services, which today include a full range of RF & Network design, engineering & support; network design tools; measurement hardware; and software services; as

well as time-critical engineering-related services such as business planning, zoning hearing expert witness testimony, regulatory advisory assistance, and project management.

Before forming V-COMM, Mr. Villecco spent 10 years with Comcast Corporation, where he held management positions of increasing responsibility, his last being Vice President of Wireless Engineering for Comcast International Holdings, Inc. Focusing on the international marketplace, Mr. Villecco helped develop various technical and business requirements for directing Comcast's worldwide wireless venture utilizing current and emerging technologies (GSM, PCN, ESMR, paging, etc.).

Previously he was Vice President of Engineering and Operations for Comcast Cellular Communications, Inc. His responsibilities included overall system design, construction and operation, capital budget preparation and execution, interconnection negotiations, vendor contract negotiations, major account interface, new product implementation, and cellular market acquisition. Following Comcast's acquisition of Metrophone, Mr. Villecco successfully merged the two technical departments and managed the combined department of 140 engineers and support personnel.

Mr. Villecco served as Director of Engineering for American Cellular Network Corporation (AMCELL), where he managed all system implementation and engineering design issues. He was responsible for activating the first cellular system in the world utilizing proprietary automatic call delivery software between independent carriers in Wilmington, Delaware. He also had responsibility for filing all FCC and FAA applications for AMCELL before it was acquired by Comcast.

Prior to joining AMCELL, Mr. Villecco worked as a staff engineer at Sherman and Beverage (S&B), a broadcast consulting firm. He designed FM radio station broadcasting systems and studio-transmitter link systems, performed AM field studies and interference analysis and TV interference analysis, and helped build a sophisticated six-tower arrangement for a AM antenna phasing system. He also designed and wrote software to perform FM radio station allocations pursuant to FCC Rules Part 73.

Mr. Villecco started his career in telecommunications engineering as a wireless engineering consultant at Jubon Engineering, where he was responsible for the design of cellular systems, both domestic and international, radio paging systems, microwave radio systems, two-way radio systems, microwave multipoint distribution systems, and simulcast radio link systems, including the drafting of all FCC and FAA applications for these systems.

Mr. Villecco has a BSEE from Drexel University, in Philadelphia, and is an active member of IEEE. Mr. Villecco also serves as an active member of the Advisory Council to the Drexel University Electrical and Computer Engineering (ECE) Department.

Relevant Expert Witness Testimony Experience:

Over the past five years, Mr. Villecco had been previously qualified and provided expert witness testimony in the states of New Jersey, Pennsylvania, Delaware and Michigan. Mr. Villecco has also provided expert witness testimony in the following cases:

- United States Bankruptcy Court
- Nextwave Personal Communications, Inc. vs. Federal Communications Commission (FCC) **
- Pocket Communications, Inc. vs. Federal Communications Commission (FCC) **

** In these cases, Mr. Villecco was retained by the FCC and the Department of Justice as a technical expert on their behalf, pertaining to matters of wireless network design, optimization and operation.

David K. Stern
Vice President and Co-Founder
V-COMM, L.L.C.

David Stern, Vice President and co-founder of V-COMM, has over 20 years of hands-on operational and business experience in telecommunications engineering. He began his career with Motorola, where he developed an in-depth knowledge of wireless engineering and all the latest technologies such as CDMA, TDMA, and GSM, as well as AMPS and Nextel's iDEN.

While at V-COMM, Mr. Stern oversaw the design and implementation of several major Wireless markets in the Northeast United States, including Omnipoint - New York, Verizon Wireless, Unitel Cellular, Alabama Wireless, PCS One and Conestoga Wireless. In his position as Vice President, he has testified at a number of Zoning and Planning Boards in Pennsylvania, New Jersey and Michigan.

Prior to joining V-COMM, Mr. Stern spent seven years with Comcast Cellular Communications, Inc., where he held several engineering management positions. As Director of Strategic Projects, he was responsible for all technical aspects of Comcast's wireless data business, including implementation of the CDPD Cellular Packet Data network. He also was responsible for bringing into commercial service the Cellular Data Gateway, a circuit switched data solution.

Also, Mr. Stern was the Director of Wireless System Engineering, charged with evaluating new digital technologies, including TDMA and CDMA, for possible adoption. He represented Comcast on several industry committees pertaining to CDMA digital cellular technology and served on the Technology Committee of a wireless company on behalf of Comcast. He helped to direct Comcast's participation in the A- and B-block PCS auctions and won high praise for his recommendations regarding the company's technology deployment in the PCS markets.

At the beginning of his tenure with Comcast, Mr. Stern was Director of Engineering at Comcast, managing a staff of 40 technical personnel. He had overall responsibility for a network that included 250 cell sites, three MTSOs, four Motorola EMX-2500 switches, IS-41 connections, SS-7 interconnection to NACN, and a fiber optic and microwave “disaster-resistant” interconnect network.

Mr. Stern began his career at Motorola as a Cellular Systems Engineer, where he developed his skills in RF engineering, frequency planning, and site acquisition activities. His promotion to Program Manager-Northeast for the rapidly growing New York, New Jersey, and Philadelphia markets gave him the responsibility for coordinating all activities and communications with Motorola’s cellular infrastructure customers. He directed contract preparations, equipment orders and deliveries, project implementation schedules, and engineering support services.

Mr. Stern earned a BSEE from the University of Illinois, in Urbana, and is a member of IEEE.

Sean Haynberg
Director of RF Technologies
V-COMM, L.L.C.

Sean Haynberg, Director of RF Technologies at V-COMM, has over 14 years of experience in wireless engineering. Mr. Haynberg has extensive experience in wireless system design, implementation, testing and optimization for wireless systems utilizing CDMA, TDMA, GSM, AMPS and NAMPS wireless technologies. In his career, he has conducted numerous first office applications, compatibility & interference studies, and new technology evaluations to assess, develop and integrate new technologies that meet industry and FCC guidelines. His career began with Bell Atlantic NYNEX Mobile, where he developed an in-depth knowledge of wireless engineering.

While at V-COMM, Mr. Haynberg was responsible for the performance of RF engineering team supplying total RF services to a diverse client group. Projects varied from managing a team of RF Engineers to design and implement new a PCS wireless network in the NY MTA; to the wireless system design & expansion of international markets in Brazil and Bermuda; to system performance testing and optimization for numerous markets in the north and southeast; to the development and procurement of hardware and software engineering tools; to special technology evaluations, system compatibility and interference testing. He has also developed tools and procedures to assist carriers in meeting compliance with FCC rules & regulations for RF Safety, and other FCC regulatory issues. In addition, Mr. Haynberg was instrumental in providing leadership, technical analysis, engineering expertise, and management of a team of RF Engineers to deliver expert-level engineering analysis & reporting on behalf of the FCC & Department of Justice, in the Nextwave and Pocket Communications Bankruptcy proceedings.

Prior to joining V-COMM, Mr. Haynberg held various management and engineering positions at Bell Atlantic NYNEX Mobile (BANM). He was responsible for evaluating new technologies

and providing support for the development, integration and implementation of first office applications (FOA), including CDMA, CDPD, and RF Fingerprinting Technology. Beyond this, Haynberg provided RF engineering guidelines and recommendations to the company's regional network operations, supported the deployment and integration of new wireless equipment and technologies, including indoor wireless PBX/office systems, phased/narrow-array smart antenna systems, interference and inter-modulation analysis and measurement, and cell site co-location and acceptance procedures. He was responsible for the procurement, development and support of engineering tools for RF, network and system performance engineers to enhance the system performance, network design and optimization of the regional cellular networks. He began his career as an RF Engineer responsible for the system design and expansion of over 100 cell sites for the cellular markets in New Jersey, Philadelphia, PA; Pittsburgh, PA; Washington, DC; and Baltimore, MD market areas.

Mr. Haynberg earned a Bachelor of Science degree in Electrical Engineering with high honors, and attended post-graduate work, at Rutgers University in Piscataway, New Jersey. While at Rutgers, Mr. Haynberg received numerous honors including membership in the National Engineering Honor Societies Tau Beta Pi and Eta Kappa Nu. In addition, Mr. Haynberg has qualified and provided expert witness testimony in the subject matter of RF engineering and the operation of wireless network systems for many municipalities in the State of New Jersey.